

Space Plasma Environment Induced Luminescence of Materials on Space Based Observatories

Completed Technology Project (2012 - 2015)



Project Introduction

The space plasma environment creates a harsh setting in which spacecraft reside. Spacecraft charging is the accumulation of an electrical charge on orbiting spacecraft induced by the space plasma environment and has harmful effects on the electrical functionality of a spacecraft. This has been and continues to be studied extensively, particularly in the Materials Physics Group (MPG) at Utah State University (USU). In recent charging studies performed by the MPG, we found another potentially problematic affect the space plasma environment can impose on spacecraft that requires further investigation. During these standard charging tests, we observed light emanating from the surface of the sample undergoing electron beam bombardment. Thus, we can expect that the bombardment of sufficiently energetic, charged particles from the space plasma on a spacecraft may cause some of the material to glow, or luminesce. With NASAs development of new, more advanced and sensitive space based observatories, it will be important to study and understand plasma induced luminescence of space based observatory materials. If the glow from the material is within the field of view of the collection optics or emanating from the collection optics themselves, the observatory images will be tainted by this light contamination. As the topic of my graduate research, I propose further experimentation and more detailed quantitative analysis of the plasma induced luminescence of materials, in particular those used in space observatory. With other members of the MPG, I have designed and conducted charging and luminescence studies at USU. The primary focus of recent studies has been on space observatory materials, including carbon composite materials with an epoxy layer, multiple variations of Kapton, and the optical coating, SiO₂. Luminescence was found to be almost ubiquitous throughout the testing, with the intensity dependent on the following external parameters: incident particle energy and flux, exposure and recovery time, and the temperature. The ability to collect accurate data is affected by these external parameters and the luminescent decay time, a property unique to each material. It is important to minimize the luminescence within the collection band width of the materials within the field of view of the collection optics or of the collection optics themselves. With my research on the luminescent phenomenon of these spacecraft materials, including the development of working models of the physical behaviors responsible for this behavior, NASA will be able to better design, build and operate their space-based observatories and produce higher quality images of the final frontier.

Anticipated Benefits

With NASAs development of new, more advanced and sensitive space based observatories, it will be important to study and understand plasma induced luminescence of space based observatory materials. If the glow from the material is within the field of view of the collection optics or emanating from the collection optics themselves, the observatory images will be tainted by this light contamination. This project includes experimentation and detailed



Project Image Space Plasma Environment Induced Luminescence of Materials on Space Based Observatories

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Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Responsible Program:

Space Technology Research Grants

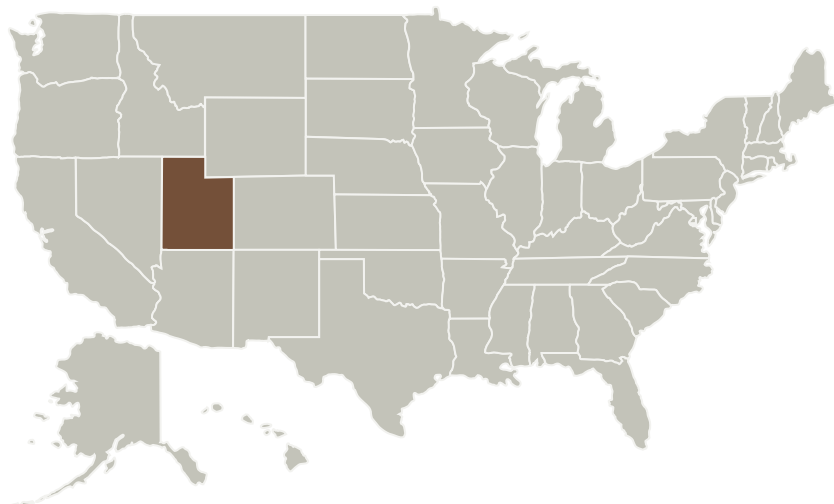
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quantitative analysis of the plasma induced luminescence of materials, in particular those used in space observatory.

Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
Utah State University(USU)	Supporting Organization	Academia Alaska Native and Native Hawaiian Serving Institutions (ANNH)	Logan, Utah

Primary U.S. Work Locations

Utah

Project Management

Program Director:

Claudia M Meyer

Program Manager:

Hung D Nguyen

Principal Investigator:

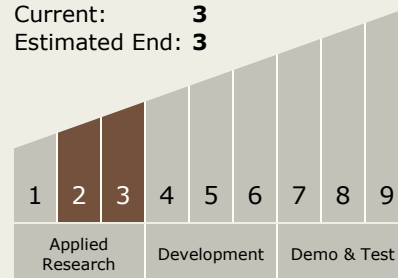
Jr Dennison

Co-Investigator:

Amberly E Jensen

Technology Maturity (TRL)

Start: 2
Current: 3
Estimated End: 3



Technology Areas

Primary:

- TX12 Materials, Structures, Mechanical Systems, and Manufacturing
 - TX12.1 Materials
 - TX12.1.1 Lightweight Structural Materials

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Images



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Project Image Space Plasma
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(<https://techport.nasa.gov/image/1827>)

Project Website:

<https://www.nasa.gov/directorates/spacetech/home/index.html>